



Eels of the genus *Bathyuroconger* in the northwestern Pacific, with descriptions of four new species (Anguilliformes: Congridae)

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Abstract

Examination of the congrid genus *Bathyuroconger* in the northwestern Pacific reveals six species are present. *Bathyuroconger albus* **sp. nov.** differs from congeners in having a pale coloration, a moderately reduced gill opening that is close to but not touching the pectoral-fin base, trunk length 2.0–2.9 times HL, preanal vertebrae 45–54, preanal lateral-line pores 42–48. *Bathyuroconger dolichosomus* **sp. nov.** has a moderately reduced gill opening that is close to but not touching the pectoral-fin base, trunk length 3.2 times HL, preanal vertebrae 63, and preanal lateral-line pores 61. *Bathyuroconger fowleri* **sp. nov.** has a small gill opening distant from the pectoral-fin base, trunk length 1.7–2.1 times head length, dorsal-fin origin over middle of pectoral fin, predorsal vertebrae 10–14, preanal vertebrae 48–52, total vertebrae 173–178. *Bathyuroconger hawaiiensis* **sp. nov.** has a slightly reduced gill opening, separated from the pectoral-fin base, dark color, total vertebrae 201–210. *Bathyuroconger parvibranchialis* (Fowler, 1934), redescribed herein, has a small gill opening distant from the pectoral-fin base, dorsal-fin origin over base of pectoral fin, trunk length 1.4–1.7 times in HL, preanal vertebrae 43–48, total vertebrae 181–189, and a uniformly dark color in adults. *Bathyuroconger* cf. *vicinus* has a full-size gill opening in contact with pectoral-fin base, dark color, and total vertebrae 196–201. A key to the species in the northwestern Pacific is provided.

Key words: Pisces, Elopomorpha, Taxonomy, Congridae, new species

Introduction

Bathyuroconger contains a still-undetermined number of species that occur in deep tropical and subtropical waters around the world except the eastern Pacific. Despite its broad distribution and relatively common occurrence in its depth range, it remains poorly understood. It was originally described by Fowler (1934) as a subgenus of *Uroconger* to contain *Uroconger braueri* Weber & de Beaufort, 1916.

Shortly thereafter, Reid (1934:3) raised it to full generic level. Castle (1968:711) returned it to its status as a subgenus of *Uroconger*, in which he included three species: *Uroconger lepturus* (Richardson, 1845) from the Indo-Pacific, *U. braueri* from the Indian Ocean, and *U. vicinus* Vaillant, 1888, described from the eastern Atlantic. Castle, however, clearly confused the various species of *Uroconger*, *Bathyuroconger*, and *Bathycongrus* (treated as *Congrina* Jordan & Hubbs), many of which he had not directly examined.

Blache & Bauchot (1976:405) reinstated *Bathyuroconger* as a genus and tentatively synonymized *B. braueri* with *B. vicinus*. Smith (1989a:541) followed this treatment, pointing out the variation and overlap in the characters that might distinguish them. Meanwhile, Fowler (1934:274) had described another new genus, *Silvesterina*, to contain his new species *S. parvibranchialis* from the Philippines and Indonesia, distinguished by its very small gill opening. He did not note the resemblance in other characters to *Bathyuroconger*.

Smith (1989a:541) pointed out the similarity but retained the two genera as distinct, based on the difference in size of the gill opening. Smith (1999: 1686) finally synonymized them. Based on the new species described below,

it is apparent that the size of the gill opening varies considerably among the species and does not clearly divide them into two groups. It is further likely that, considering its wide distribution across three ocean basins, *Bathyuroconger vicinus* in fact represents a complex of species. Further studies, including genetic data, are needed to sort out these species and define them properly.

In the present study, we examined all known specimens of the genus *Bathyuroconger* collected from the northwestern Pacific from Indonesia to Hawaii. Six species were recognized by using morphological characters such as size of gill opening, distance between gill opening and pectoral-fin base, body proportions, vertebral numbers, lateral-line pores, and body color. Here we redescribe *B. parvibranchialis* and add four species new to science. Another species, treated as *B. cf. vicinus*, was also found; its status is still uncertain.

Methods and materials

Methods for taking measurements and counts follow Smith (1989a). An exception is made in the case of the gill opening. In most congrid, this is measured from the upper corner where it meets the base of the pectoral fin to the lower corner where it meets the body below the pectoral fin. In some species of *Bathyuroconger*, however, the gill opening is separated from the pectoral fin and forms a pore-like structure without corners. Therefore, we have measured the gill opening as the greatest diameter. Unless otherwise indicated, all lengths are total length (TL). The tails are commonly damaged and morphometric data are also presented as percentage of preanal length. Abbreviations of morphometric characters are as follows: DA, depth at anus; E, eye diameter; GO, gill opening; HL, head length; IB, interbranchial distance; IOW, interorbital width; PAL, preanal length; PDL, predorsal length; PL, pectoral-fin length; S, snout length; TR, trunk length; UJ, upper-jaw length. Abbreviations of meristic characters are as follows: PALL, preanal lateral-line pores; PDLL, predorsal lateral-line pores; PPLL, prepectoral lateral-line pores; IO, infraorbital pores; POM, preoperculomandibular pores; SO, supraorbital pores; ST, supratemporal pores; PAV, preanal vertebrae; PCV, precaudal vertebrae; PDV, predorsal vertebrae; TV, total vertebrae. Specimens are deposited at USNM, ASIZP, NMMB-P, NMST-P, BPBM, and BSKU. Institutional abbreviations follow Fricke & Eschmeyer (2017, online version).

Results

Family Congridae

Genus *Bathyuroconger* Fowler, 1934

Bathyuroconger (subgenus of *Uroconger*) Fowler, 1934:273 (type species *Uroconger braueri* Weber & de Beaufort, 1916, by original designation).

Silvesterina Fowler, 1934:274 (type species *Silvesterina parvibranchialis* Fowler, 1934 by original designation).

Characters. Body moderately elongate, preanal length 33–42% TL, tail slender and attenuate; rather delicate in composition, remaining quite limp in preservative; skin thin, slimy, rather transparent and loosely attached. Dorsal fin beginning over or slightly behind base of pectoral fin. Gill opening variable, from semi-circular, moderate in size, with upper corner touching base of pectoral fin to a small pore widely separated from fin.

Head large and robust in comparison to body; mouth terminal, jaws nearly equal or upper jaw slightly projecting; fleshy part of snout not projecting beyond intermaxillary teeth; labial flange absent from both jaws. Anterior nostril in a short tube, near tip of snout, directed anterolaterally; posterior nostril small, round, in front of eye at mid-eye level.

Lateral line complete. Head pores moderate to large in size, not greatly enlarged or slit-like (Fig. 1); supraorbital with 3 pores (rarely 4), all at tip of snout; infraorbital with 5 pores, first pore (adnasal) above anterior nostril, three pores along upper jaw and 1 behind rictus; no pores behind or between eyes; mandibular with 7 pores (rarely 6 or 8), 6 pores along lower jaw and 1 behind rictus; preopercular with 3 pores; 1 single pore on supratemporal canal.

Teeth strong, fang-like (Fig. 2). Intermaxillary teeth enlarged, in two transverse rows, separated from maxillary

and vomerine teeth. Vomerine teeth few, usually 1 or 2 enlarged median teeth, with a few small teeth around and behind them; the vomerine tooth patch relatively short. Maxillary teeth in narrow bands, wider anteriorly, the outer teeth largest. Dentary teeth in two or three irregular rows, the anterior outer teeth enlarged.

Color variable, from dark brown to light gray. Smaller specimens often with two or three rows of small melanophores along the body, presumably the remains of larval pigment.

Remarks. Although it has been commonly compared and confused with *Uroconger*, the relationships of *Bathyuroconger* clearly lie with *Bathycongrus*. *Uroconger* is easily distinguished by its long single row of vomerine teeth, which extends nearly the entire length of the upper jaw. *Bathyuroconger* and *Bathycongrus*, in contrast, have a short vomerine tooth patch restricted to the anterior end of the mouth, commonly with one or a few enlarged teeth with smaller teeth around them. The remains of the larval pigmentation, commonly seen in small specimens, consists of three irregular longitudinal rows above, on, and below the mid-line, similar to the pattern seen in larvae of *Bathycongrus* (Castle, 1969). Larval *Uroconger* have a single midlateral row of melanophores (Nair, 1946; Nair & Mohamed, 1960; Smith, 1989b:751). *Bathyuroconger* differs from *Bathycongrus* primarily in the relatively large and deep head, larger teeth, the equal length of the upper and lower jaws, and the more delicate and easily damaged body.

Key to species of *Bathyuroconger* in the western North Pacific

- 1A. Gill opening moderate to large, immediately adjacent to pectoral-fin base, its upper corner contacting base of fin *B. cf. vicinus* (Indonesia, Papua New Guinea)
- 1B. Gill opening small to moderate, distinctly separated from base of pectoral fin 2
- 2A. Trunk length 3.3 times head length; preanal vertebrae 63, precaudal vertebrae 70 *B. dolichosomus* **sp. nov.** (Taiwan)
- 2B. Trunk length less than 2.9 times head length; preanal vertebrae fewer than 55 3
- 3A. Gill opening moderately small, separated from pectoral-fin base by a distance of less than diameter of gill opening 4
- 3B. Gill opening very small, separated from pectoral-fin base by a distance greater than diameter of gill opening 5
- 4A. Body light grayish dorsally and pale ventrally; vertebrae 168–177 *B. albus* **sp. nov.** (Taiwan)
- 4B. Body uniformly brown; vertebrae 201–210 *B. hawaiiensis* **sp. nov.** (Hawaii)
- 5A. Dorsal-fin origin over base of pectoral fin; trunk length 1.4–1.7 times head length; preanal vertebrae 43–48; total vertebrae 181–189 *B. parvibranchialis* (Philippines, Taiwan, Japan)
- 5B. Dorsal-fin origin over middle of pectoral fin; trunk length 1.7–2.2 times head length; preanal vertebrae 47–52; total vertebrae 173–178 *B. fowleri* **sp. nov.** (Indonesia, Philippines)

Bathyuroconger albus **sp. nov.**

English name: White large-toothed conger

Figs. 2, 3, 4, 5A; Tables 1, 2

Bathyuroconger vicinus (not of Vaillant, 1888): Shao *et al.*, 2008:239 (in part). Smith, 1999:1686 (in part). Ho *et al.*, 2015:146 (in part).

Holotype. USNM 400323 (1, 432), Daxi, Yilan, northeastern Taiwan, bottom trawl, 4 May 2010.

Paratypes. Collected from Daxi, Yilan, northeastern Taiwan. ASIZP 60162 (6, 190+–429), 650 m, 15 Sep. 1997. ASIZP 60175 (1, 294), 30 Nov. 1997. ASIZP 61124 (2, 177+–206), 500 m, 7 Dec. 2000. ASIZP 61475 (1, 302), 400 m, 13 Jul. 2000. ASIZP 63134 (8, 360–585+), 24.81–24.82° N, 122.07–122.18° E, 350–650 m, 24 Apr. 2004. ASIZP 63251 (1, 337), 21 Mar. 2004. BSKU 50487 (1, 492), 23 Apr. 2012. NMMB-P11157 (1, 625), NMMB-P11158 (2, 380–430), 8 Dec. 2010. NMMB-P22058 (10, 320–480), 1 Dec. 2014. NMMB-P 26391 (3, 487–615), 28 Jun. 2017. USNM 400322 (1, 493+), 4 May 2010. USNM 400324 (1, 416+), 4 May 2010. USNM 400325 (6, 193+–375), 4 May 2010. Collected from Suao, Yilan : CAS 216686 (1, 295+), 24 Jul. 2001. Collected from Dong-gang, Pingtung, southwestern Taiwan, South China Sea: NMMB-P26613 (1, 475+), NMMB-P26614 (1, 713), NMMB-P26615 (2, 600+–658), NMMB-P26616 (1, 468), 23 Jul. 2017; USNM 437346 (1, 520+), 22 May 2014.

Non-types. ASIZP 63293 (4, 398+–615+), 24.81–24.82°N, 122.07–122.18°E, off Daxi, Yilan, NE Taiwan, 24 Apr. 2004. USNM 377318 (1, 315+), 24.83°N, 122.00°E, Daxi, Yilan, NE Taiwan, 300–600 m, 27 Mar. 2004. ASIZP 66175 (1, 290), CD321, South China Sea, 954 m, 19 Aug. 2005. NMMB-P1799 (1, 410), Daxi, NT Taiwan,

9 Sep. 2003. NMMB-P11152 (1, 271), Daxi, NE Taiwan, 5 Jun. 2010. NMMB-P21654 (1, 230), Dong-gang, SW Taiwan, 27 Aug. 2008.

Diagnosis. *Bathyuroconger albus* is distinguished from the other species by its pale coloration, light grayish-brown dorsally and lighter ventrally, head with pigmentation under skin and covered by semi-transparent unpigmented skin; a moderately reduced gill opening separated from pectoral-fin base by a distance less than diameter of gill opening; and 168–177 vertebrae.

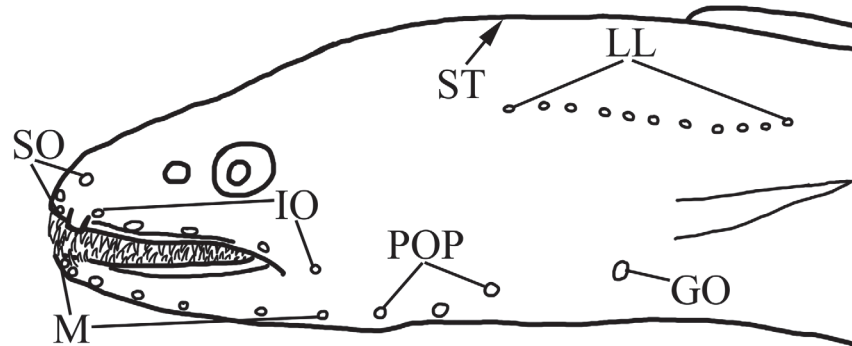


FIGURE 1. Demonstration of head pores of *Bathyuroconger* species. GO, gill opening; IO, infraorbital pores; LL, lateral-line pores; M, mandibular pores; POP, preopercular pores; SO, supraorbital pores; ST, supratemporal pore (indicated by arrow). From *B. parvibranchialis*, ASIZP 63789.

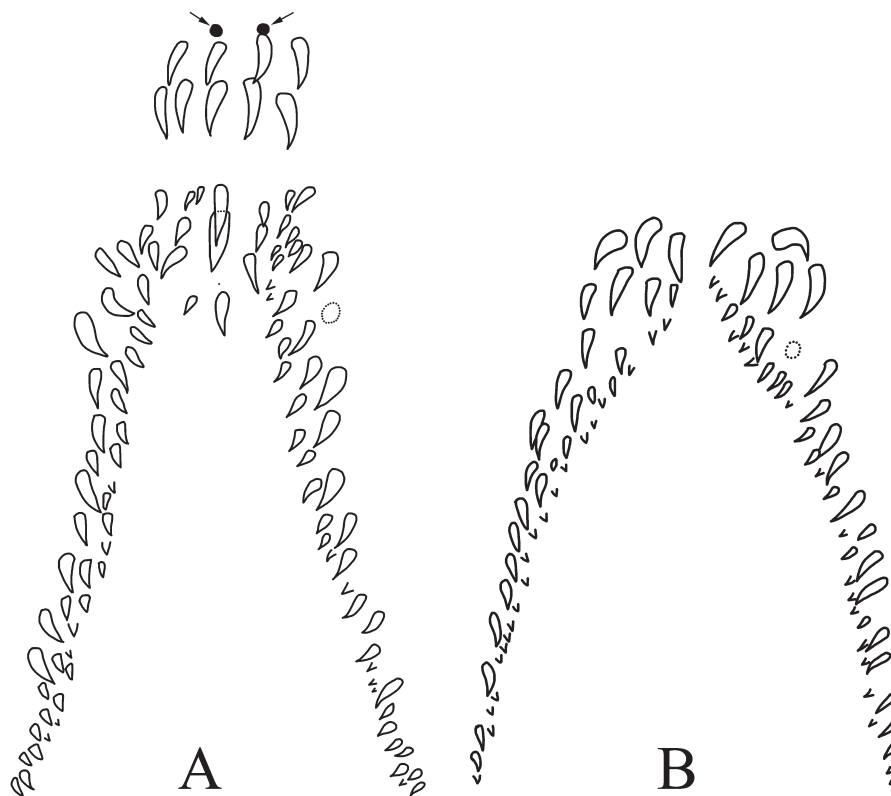


FIGURE 2. Demonstration of tooth pattern of *Bathyuroconger* species. A. upper jaw, arrow indicates first SO pore on each side. B. lower jaw. From *B. albus* **sp. nov.**, NMMB-P11157, paratype.



A



B



C

FIGURE 3. *Bathyuroconger albus* sp. nov. A. holotype, USNM400323, 432 mm TL. B–C. paratype, NMMB-P11157, 625 mm TL. Fresh condition; not to scale.

Description. Measurements in %TL: PAL 35.8–41.8, PDL 13.8–16.2, HL 10.9–12.6, TR 24.8–30.9, DA 4.0–7.0. In % PAL: PDL 33.5–43.3, HL 25.6–33.7, TR 66.3–74.4, DA 10.0–19.2. In % HL: S 21.6–26.0, E 9.7–15.7, IOW 15.0–23.2, UJ 30.7–42.3, GO 5.1–18.6, IB 19.6–42.7, PL 29.4–49.0. Pores: PALL 42–48, PDL 7–11, PPLL 4–6, SO 3, IO 5, POM 10 (rarely 9), ST 1. Vertebrae: PDV 10–14, PAV 45–54, PCV 53–58, TV 168–177.

Body slender, cylindrical anteriorly, gradually tapering and compressed posteriorly, tail thin, anus anterior to mid-body at slightly more than one-third total length. Dorsal and anal fins confluent with caudal fin; dorsal fin begins above posterior half of pectoral fin; anal fin begins immediately behind anus. Head stout, rounded, deeper than body; jaws nearly equal. Snout short and blunt, rounded in dorsal view, about 1.1–2.6 times eye diameter. Eye moderate, over posterior third of upper jaw, posterior margin at level of rictus; interorbital space relatively broad, its width greater than eye diameter. Anterior nostril short and tubular, at front of snout; posterior nostril in front of mid-eye, a simple pore. Gill opening moderately small, separated from pectoral-fin base by a distance less than diameter of gill opening, its upper end at level of lower pectoral-fin base.

Head pores moderately enlarged, not elongate and slit-like. Supraorbital pores 3; first pore small, at tip of snout on edge of upper lip; second pore larger, above and behind first, at level of and anterior to anterior nostril; third pore slightly larger and above anterior nostril; no pores on interorbital space. Infraorbital pores 5; first immediately behind anterior nostril; second below and behind first, on edge of lip between anterior and posterior nostrils; third below anterior margin of eye; fourth below posterior part of eye; fifth behind rictus. Preoperculo-mandibular pores 10 (rarely 9); 7 (rarely 6) on mandibular section and 3 on preopercular, the last one at about level of first lateral-line pore. A single supratemporal pore with tube-like rim, anterior to level of first lateral-line pore. Lateral line complete, lateral-line pores large; predorsal 7–11 (mean 9); prepectoral 4–6 (mean 5); preanal 42–48 (mean 45).

Vertebrae: predorsal 10–14; preanal 45–54; precaudal 53–58; total 168–177, MVF 13–49–173. ASIZP 66175 has 8 predorsal vertebrae and ASIZP 63293 (1 of 4, 398+ mm) has 6 predorsal vertebrae, both are clearly fewer than other specimens.

Teeth large and pointed, generally smaller than those of the *B. vicinus* group. Intermaxillary teeth in two transverse rows, each with 4–6 enlarged fang-like teeth, exposed when mouth closed. Vomer with 2 large median teeth and 2–8 small teeth beside and/or behind. Maxilla with 3 irregular rows of teeth on anterior portion, becoming 2 rows posteriorly, those in outermost row larger and scattered in arrangement. Dentary with 4 irregular rows of enlarged teeth on anterior portion, those on outer 2 rows fang-like and exposed when mouth fully closed, gradually narrowing to 2 rows posteriorly, those of outermost row larger.

Coloration. Pale grayish-brown in preservative, somewhat darker dorsally; head with pigmentation under skin and covered by semi-transparent unpigmented skin; dorsal half of anterior two-thirds and posterior one-third of body grayish brown; ventral half of anterior two-thirds of body whitish or only covered by scattered pigmentation; irregular but clear boundary between pigmented and unpigmented areas. Pectoral fin transparent; dorsal and anal fin white in anterior portion, some with internal pigmentation on rays, gradually becoming pale basally and with broad black margin posteriorly; caudal fin black. Oral cavity and tongue grayish; gill chamber grayish, gill cover region grayish from outside view. Peritoneum blackish, gut and stomach black.

Distribution. This species is currently known only from Taiwan, where it seems to be the most common species of *Bathyuroconger*. Specimens were collected at depths of ca. 300–954 m.

Ecological note. All specimens were collected by bottom trawl together with many demersal fishes, which may indicate this species lives near the bottom. Smith (1989a) commented that the enlarged sensory pores and the soft body may suggest that this species lives associated with the bottom but is more or less pelagic.

Etymology. From the Latin *albus*, white, in reference to its pale coloration compared to other congeners.

Remarks. *Bathyuroconger albus* **sp. nov.** has been confused with *B. vicinus*, a species described from the Atlantic and reported to occur worldwide. It differs primarily in the coloration and the size and position of the gill opening. *Bathyuroconger albus* is lightly pigmented dorsally and pale ventrally, whereas *B. vicinus* is brownish to blackish. In *B. albus*, the gill opening is smaller and separated from the pectoral-fin base; in *B. vicinus* the gill opening is larger and in contact with the pectoral-fin base. It has 168–177 total vertebrae, whereas the various *B. vicinus* populations have 180–186; it also has 53–58 precaudal vertebrae vs. 57–66 in *B. vicinus*. Although overlapping, the snout length, eye diameter, upper-jaw length and gill opening relative to head length are smaller in *B. albus* than *B. vicinus*. Moreover, the fang-like teeth in the jaws are generally smaller in *B. albus* than in *B. vicinus*.

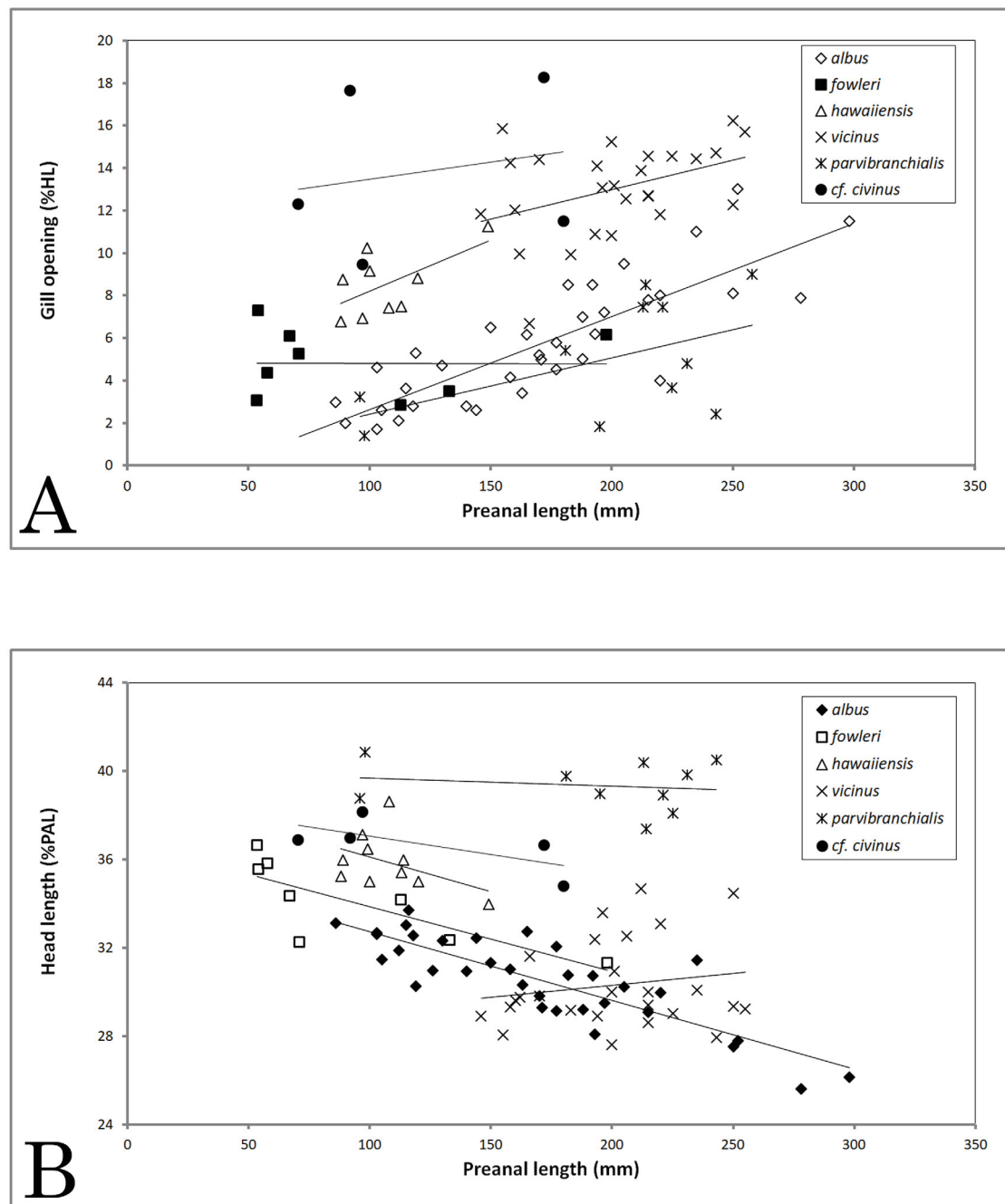


FIGURE 4. Scatter plots demonstrating the different morphometric proportion of *Bathyuroconger* species in present study. A. gill opening height (%HL) versus preanal length. B. Head length (%PAL) versus preanal length.

It differs from *B. hawaiiensis* in the paler color (dark brown in *B. hawaiiensis*) and fewer vertebrae (168–177 vs 201–210).

Bathyuroconger albus is similar to *B. dolichosomus* **sp. nov.** described below in the coloration and gill opening, but it is clearly distinguished by the shorter trunk (2.0–2.9 vs 3.2 times in head length), fewer preanal lateral-line pores (42–48 vs 61), and fewer preanal vertebrae (45–54 vs 63).

TABLE 1. Morphometric and meristic data of three *Bathyrcong* species and comparative data of *B. vicinus*. HT =Holotype.

	<i>B. albus</i> sp. nov.		<i>B. vicinus</i>		<i>B. dolichosomus</i> sp. nov.		<i>B. fowleri</i> sp. nov.	
	HT	NE Taiwan	SW Taiwan	Nontypes	HT	HT	HT	All types
TL (mm)	432	193+–608 (n=30)	475–713 (n=6)	250–660+ (n=26)	350+	298	145–497 (n=8)	
% TL								
PAL	39.4	38.5 (35.8–41.4)	41.0 (40.2–41.8)	39.0 (37.9–40.5)	–	37.9	38.1 (36.9–39.8)	
PDL	14.4	14.8 (13.8–16.2)	14.9 (14.9–15.0)	13.9 (12.9–15.4)	–	15.9	15.1 (14.5–15.9)	
HL	11.7	11.9 (11.0–12.6)	11.3 (10.9–11.7)	12.0 (11.2–13.1)	–	13.0	13.0 (12.3–13.5)	
Tail	60.6	61.5 (58.6–64.2)	59.0 (58.2–59.8)	61.0 (59.5–62.1)	–	3.0	2.2 (1.2–3.0)	
TR	27.6	26.7 (24.8–29.9)	29.7 (28.4–30.9)	27.0 (24.8–28.9)	–	25.0	25.1 (23.4–27.4)	
DA	4.8	5.3 (4.0–7.0)	6.5 (6.5)	4.1 (3.0–5.8)	–	6.1	6.2 (6.1–6.5)	
% PAL								
PDL	36.5	38.2 (34.9–43.3)	35.3 (33.5–37.1)	35.3 (31.6–40.7)	28.9	41.9	40.0 (36.4–41.9)	
HL	29.8	31.2 (27.8–33.7)	27.8 (25.6–29.5)	30.3 (27.6–34.7)	23.9	34.2	34.0 (31.3–36.6)	
TR	70.2	68.9 (66.3–72.2)	72.2 (70.5–74.4)	69.7 (65.3–72.4)	76.1	65.8	66.0 (63.4–68.7)	
DA	12.1	13.3 (10.0–17.9)	15.9 (13.6–19.2)	9.5 (7.5–11.5)	9.6	16.2	16.3 (14.7–17.0)	
%HL								
S	22.9	23.7 (21.6–26.0)	24.5 (24.0–25.0)	26.0 (23.6–29.6)	26.4	23.3	23.9 (21.5–25.6)	
E	13.8	12.1 (9.7–15.7)	14.0 (12.0–14.8)	12.6 (10.0–15.0)	11.4	15.5	14.0 (12.2–15.5)	
IOW	19.7	18.1 (15.0–21.0)	20.9 (17.6–23.2)	17.7 (13.9–20.7)	23.2	19.9	17.6 (14.3–19.9)	
UJ	36.1	34.8 (30.7–40.6)	38.0 (31.2–42.3)	36.5 (32.8–39.7)	37.4	33.9	35.6 (31.9–38.9)	
GO	10.3	10.6 (5.1–18.6)	11.9 (9.1–14.8)	13.6 (6.7–27.5)	8.8	2.8	4.8 (2.8–7.3)	
IB	32.00	27.2 (19.6–40.0)	35.4 (25.6–42.7)	22.8 (17.5–31.1)	26.9	28.2	21.5 (14.6–28.2)	
PL	37.1	34.6 (29.4–41.3)	41.5 (34.7–49.0)	32.8 (27.5–41.3)	29.9	29.8	31.9 (23.4–42.1)	

TABLE 2. Meristic data of all *Bathyuconger* species recognized in this study.

	<i>B. albus</i> sp. nov.		<i>B. dolichosomus</i> sp. nov.		<i>B. foweri</i> sp. nov.	
	Holotype	NE Taiwan	SW Taiwan	Holotype	Holotype	All types
Vertebrae		n=30	n=6			n=8
PDV	14	10–14	12–14	12	14	12–14
PAV	48	45–54	49–53	63	49	47–52
PCV	ca. 53	53–57	55–58	70	55	52–55
TV	174	168–175	173–177	–	175	173–178
Pores						
PALL	43	42–48	45–47	61	46	46
PDLL	10	7–11	8–10	9	12	9–12
PPLL	6	4–6	5–6	6	6	6
SO	3	3	3	3	3	3
IO	5	5	5	5	5	5
POM	10	9–10	10	10	10	10
ST	1	1	1	1	1	1

	<i>B. hawaiiensis</i> sp. nov.		<i>B. parvibranchialis</i>		<i>B. vicinus</i>	
	Holotype	All types	Holotype	Types+nontypes	Nontypes	<i>B. cf. vicinus</i>
Vertebrae		n=10		n=13	n=26	n=2
PDV	11	10–13	9	7–10	10–14	12–13
PAV	51	51–55	48	43–48	46–53	49–53
PCV	63	ca. 58–63	–	52–60	57–66	61–62
TV	210	201–210	189	181–189	180–186	196–202
Pores						
PALL	–	–	ca. 45	39–47	43–47	47–48
PDLL	8	8	7	6–8	5–10	7–9
PPLL	7	7	7	5–8	4–7	6–7
SO	3	3	3	3–4	3	3
IO	5	5	5	5	5	5
POM	10	10 (1 at 9)	10; 11	10–11	10	10
ST	1	1	1	1	1	1

Bathyuroconger albus differs from *B. parvibranchialis* and *B. fowleri* in the coloration (light gray vs brown) and larger gill opening (very small in *B. parvibranchialis* and *B. fowleri* and separated from the pectoral-fin base by a distance greater than the diameter of the gill opening). It further differs from *B. parvibranchialis* in the more posterior dorsal-fin origin (over middle of pectoral fin vs over base of pectoral fin), more predorsal vertebrae (10–14 vs 7–10), more preanal vertebrae (45–54 vs 43–48), and fewer total vertebrae (168–177 vs 181–189). It also has a greater preanal length (35.8–41.8 %TL vs 33.3–37.1) and predorsal length (13.8–16.2 %TL vs 12.6–14.5).

Although only six specimens were collected from southwestern Taiwan (South China Sea), some differences are found compared to those specimens collected from northeastern Taiwan (NW Pacific Ocean). The preanal length and trunk length in percentage of total length are slightly larger in the former than the latter. The head length in percentage of preanal length is slightly smaller in the former than the latter. The meristic data show no difference between populations.

***Bathyuroconger dolichosomus* sp. nov.**

English name: Long-body large-toothed conger

Figs. 5D, 6; Tables 1, 2

Holotype. ASIZP 65175, 350+ mm, off Daxi fishing port, Yilan, NE Taiwan, northwestern Pacific Ocean, 24 Apr. 2005, coll. H.-C. Ho

Diagnosis. A species of *Bathyuroconger* with a moderately small gill opening, its diameter 8.8% of head length, close to but not against pectoral-fin base; head length 3.2 times in trunk length, 23.9 % PAL; predorsal length 28.9 % PAL, trunk length 76.1 % PAL. Preanal lateral-line pores 61. Preanal vertebrae 63; precaudal vertebrae 70. Body lightly brownish dorsally and pale ventrally.

Description. Measurements in % PAL: PDL 28.9, HL 23.9, TR 76.1, DA 9.6. In % HL: S 26.4, E 11.4, IOW 26.9, UJ 37.4, GO 8.8, IB 26.9, PL 29.9. Pores: PALL 61, PDLL 10, PPLL 6, SO 3, IO 5, POM 10, ST 1. Vertebrae: PDV 12, PAV 63, PCV 70.

Body slender, cylindrical anteriorly, gradually tapering and compressed posteriorly; trunk very long, 3.2 times head length. Tail broken and regenerated. Dorsal fin begins above posterior half of pectoral fin. Head moderately large, rounded, slightly deeper than body, upper jaw protrudes slightly but distinctly beyond lower jaw. Snout short and blunt, rounded in dorsal view, 2.3 times eye diameter. Eye moderately large, over posterior third of upper jaw, its posterior margin at level of rictus; interorbital space relatively broad, its width greater than eye diameter. Anterior nostril tube-like, at front of snout; posterior nostril in front of mid-eye, a simple pore. Gill opening small, located anterior to pectoral fin, its upper end at level of lower pectoral-fin base, distance from gill opening to fin base less than diameter of gill opening.

Head pores moderately enlarged, not elongate and slit-like. Supraorbital pores 3; first pore at tip of snout on edge of upper lip, opening downward; second pore above first and anterior to base of anterior nostril; third pore larger, directly above anterior nostril; no pores on interorbital space. Infraorbital pores 5; first pore immediately behind anterior nostril; second between anterior and posterior nostrils; third below or slightly before anterior margin of eye; fourth below and slightly behind mid-eye; fifth behind rictus. Preoperculomandibular pores 10; 7 on mandibular section and 3 on preopercular, the last one at about level of first lateral-line pore. A single supratemporal pore with tube-like rim, anterior to level of first lateral-line pore. Lateral line complete, lateral-line pores large; predorsal 9, prepectoral 6, preanal 61.

Vertebrae: predorsal 12; preanal 63; precaudal 70; total unknown.

Teeth large and pointed, generally smaller than those of *B. vicinus*. Intermaxillary teeth in two transverse rows, 4 in anterior row and 6 in posterior, exposed when mouth closed. Vomer with 2 median teeth, the anterior one much larger, and 4 small teeth behind. Maxilla with 3 irregular rows of teeth on anterior portion, becoming 2 rows posteriorly, those on the outermost row larger and scattered in arrangement. Dentary with 4 irregular rows of enlarged teeth on anterior portion, those on outer 2 rows fang-like and exposed when mouth fully closed, gradually narrowing to 2 rows posteriorly, those on outermost row larger.

Coloration. Fresh color unknown. In preservative, dorsal half of head and anterior two-thirds and posterior one-third of body brown, becoming paler on ventral surface; ventral half of anterior two-thirds of body covered by scattered pigmentation; no clear boundary between the pigmented and unpigmented areas. Pectoral fin transparent.

Dorsal fin white anteriorly, gradually becoming pale at base with a broad black margin posteriorly. Anal fin abnormal, covered by skin similar to body color. Oral cavity and tongue grayish; gill chamber grayish, gill cover region grayish from outside view. Peritoneum blackish; gut and stomach black.

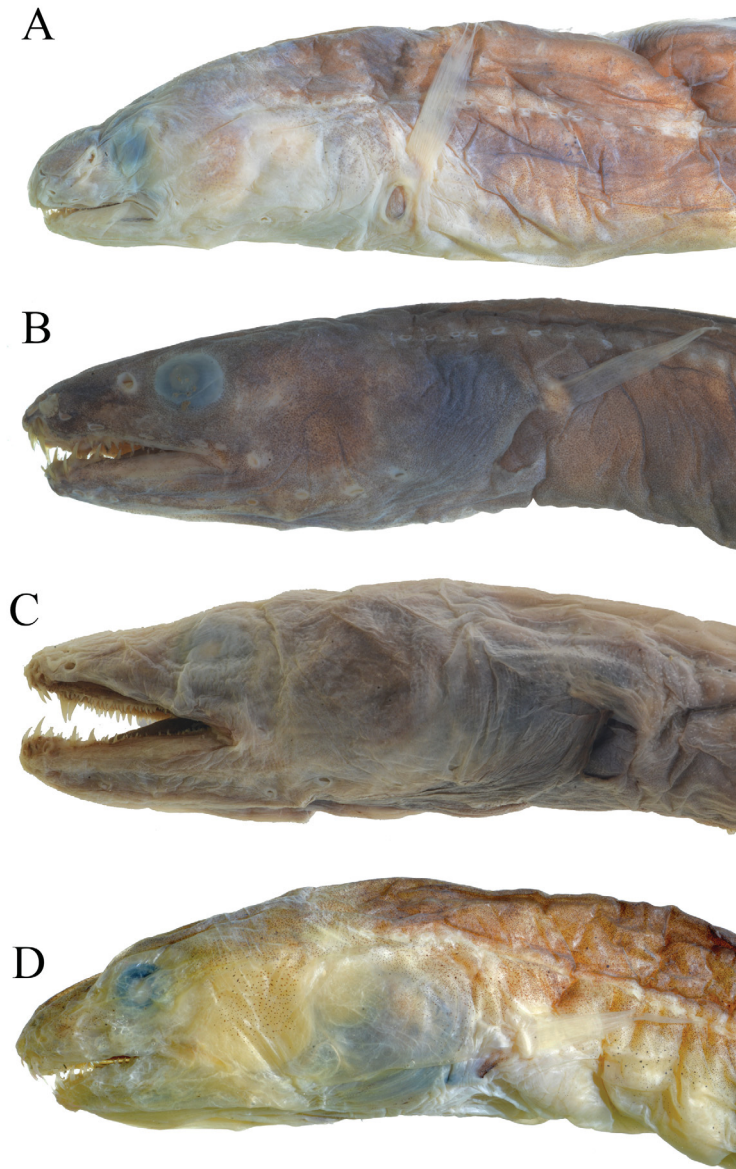


FIGURE 5. Lateral view of head of four *Bathyuroconger* species. A. *B. albus* **sp. nov.**, USNM 400322, paratype, 493+ mm TL. B. *B. vicinus*, USNM 405028, 522+ mm TL. C. *B. cf. vicinus*, USNM 135270, 445 mm TL. D. *B. dolichosomus* **sp. nov.**, holotype, ASIZP 65175, 350+ mm TL.

Distribution. Known only from the holotype collected from northeastern Taiwan.

Etymology. Named from Greek *dolichos* long + *soma* body, referring to the diagnostic characteristic of its long body. Treated as an adjective.

Remarks. *Bathyuroconger dolichosomus* **sp. nov.** is distinguished from all the other species by its long trunk, more than 3 times the head length, and the correspondingly high number of preanal vertebrae (63 vs 43–55) and precaudal vertebrae (70 vs 52–63). The holotype and only known specimen is missing a substantial part of its tail, so the total length and the total number of vertebrae are unknown. The characters listed above, however, are sufficient to distinguish it from all other known species.



FIGURE 6. *Bathyuroconger dolichosomus* sp. nov., holotype, ASIZP 65175, 350+ mm TL.

***Bathyuroconger fowleri* sp. nov.**

English name: Fowler's large-toothed conger

Figs. 4, 7, 8A; Tables 1, 2

Silvesterina parvibranchialis (non Fowler, 1934): Fowler, 1934:275 (part).

Bathyuroconger parvibranchialis: Smith, 1999:1686 (part).

Holotype. USNM 93376 (298 mm), Philippines, off northern Luzon, Hermanos Id. (N), 18.54°N, 122.02°E, 421 m, Albatross sta. 5326, 12 Nov. 1908.

Paratypes. Indonesia: USNM 93372 (1, 497), Moluccas, between Gillolo & Makayan Id., 0.20°N, 127.49°E, 527 m, Albatross 5624, 29 Nov 1909. **Philippines:** USNM 93377 (1, 275+), off northern Luzon, 18.55°N, 127.37°E, 388 m, Albatross sta. 5329, 19 Nov 1908. USNM 93379 (3, 135–186), off northern Luzon, 18.57°N, 121.85°E, 410 m, Albatross sta. 5325, 12 Nov. 1908. USNM 441776 (2, 145–155), same data as USNM 9336.

Diagnosis. A species of *Bathyuroconger* with a very small gill opening, preanal length 36.9–39.8 %TL, predorsal length 14.5–15.9 %TL, predorsal vertebrae 12–14, preanal vertebrae 47–52, total vertebrae 173–178. *Bathyuroconger fowleri* is distinguished from all other species except *B. parvibranchialis* by the very small gill opening, separated from the pectoral-fin base by a distance greater than the diameter of the gill opening (vs less than diameter of gill opening). It is distinguished from *B. parvibranchialis* by the position of the dorsal-fin origin (over base of pectoral fin vs behind base of fin); a greater preanal length (vs 33.3–37.1 %TL), greater predorsal length (vs 12.6–14.5 %TL), a greater trunk to head ratio (1.7–2.1 vs 1.4–1.7); more predorsal vertebrae (vs 7–10), more preanal vertebrae (vs 43–48), and fewer total vertebrae (vs 181–189). In addition, it appears to be somewhat smaller (largest specimen 497 mm vs 715 mm) and lives in shallower water (388–527 m vs 432–1022 m).

Description. Measurements in %TL: PAL 36.9–39.8, PDL 14.5–15.9, HL 12.3–13.5, TR 23.4–27.4, DA 6.1–6.5. In % PAL: PDL 36.4–41.9, HL 31.3–36.6, TR 63.4–68.7, DA 14.7–17.0. In % HL: S 21.5–25.6, E 12.2–15.5, IOW 14.3–19.9, UJ 31.9–38.9, GO 2.8–7.3, IB 14.6–28.2, PL 23.4–42.1. Pores: PALL 46, PDL 9–12, PPLL 6, SO 3, IO 5, POM 10, ST 1. Vertebrae: PDV 12–14, PAV 47–52, PCV 52–55, TV 173–178.

Body moderately slender, cylindrical anteriorly, compressed and tapering posteriorly. Trunk short, trunk length 1.7–2.2 times head length. Tail slender but not filamentous, anus at about anterior third of total length. Dorsal and anal fins confluent with caudal, dorsal fin begins approximately over middle of pectoral fin, anal fin begins immediately behind anus; pectoral fin moderately well developed. Head large, rounded, deeper than body, jaws equal. Snout short and blunt, rounded in dorsal view, about 1.5–2.0 times eye diameter. Eye moderately small, over posterior part of upper jaw, its posterior margin approximately at level of rictus; interorbital space relatively broad, its width greater than eye diameter. Anterior nostril tube like, at front of snout; posterior nostril in front of mid-eye, a simple pore. Gill opening small, located anteroventral to pectoral fin, its upper end below level of lower pectoral-fin base; distance from gill opening to fin base distinctly greater than diameter of gill opening.



FIGURE 7. *Bathyuroconger fowleri* sp. nov., USNM 93376, 298 mm TL.

Vertebrae: predorsal 12–14, preanal 47–52, precaudal 52–55, total 173–178.

Head pores moderate in size, not enlarged and slit-like. Supraorbital pores 3; first pore at tip of snout, on edge of upper lip, opening downward; second pore larger, above and slightly behind first, in front of upper base of anterior nostril; third above and behind second, directly above base of anterior nostril. Infraorbital pores 5; first just behind anterior nostril; second below and behind first, about midway between anterior and posterior nostrils; third below anterior margin of eye; fourth below posterior part of eye, slightly behind mid-eye level; fifth behind rictus; no pores behind eye. Preoperculomandibular pores 10; 7 in mandibular section, 3 in preopercular, the last one at about level of first lateral-line pore. One median supratemporal pore, anterior to level of first lateral-line pore; no lateral pores. Lateral line complete, lateral-line pores large; predorsal 9–12, prepectoral 6, preanal 46.

Teeth large and pointed. Intermaxillary teeth in two transverse rows, each with 4–6 fang-like teeth, exposed when mouth closed. Vomer with 2 enlarged median teeth, the second larger than the first, with a few smaller teeth around and behind them, length of patch rather short. Maxillary teeth in 3 irregular rows anteriorly, narrowing to 2 rows posteriorly, the outer teeth larger. Dentary teeth in about 3–4 rows anteriorly, biserial for most of length, the outer teeth larger, those at anterior end enlarged.

Color in preservative medium to light brown, fins with dark margin posteriorly. Smaller specimens with three longitudinal rows of small melanophores, presumably the remnant of larval pigment.

Distribution. Known from two rather widely separated localities in the tropical NW Pacific: northern Luzon in the Philippines and the Moluccas in Indonesia, depth 388–527 m. There are no obvious differences between the northern and southern specimens, and it likely occurs in the intermediate area as well. Its presence in Taiwan and farther north cannot be ruled out, as its close relative *B. parvibranchialis* was not known north of the Philippines until the present study.

Remarks. The specimens of this species are part of the type series of *Silvesterina parvibranchialis*. Fowler (1934) did not notice the distinction, but it is unlikely that any of his contemporaries would have noticed either. The differences between the two species are not obvious, and they must be examined closely to be seen. The vertebral counts are particularly revealing, but at that time, the importance of this character in the identification of eels was not generally appreciated, and x-ray machines were not widely used. In addition to the number of vertebrae, the two species are distinguished by the position of the dorsal-fin origin (over the base of the pectoral fin in *B. parvibranchialis* but distinctly behind that point in *B. fowleri*) and the position of the anus (somewhat more anterior in *B. parvibranchialis* than in *B. fowleri*, reflected in the lesser preanal length in the former). In addition, there is a distinct but difficult-to-quantify difference in the shape of the body. When compared side-by-side, *B. parvibranchialis* is seen to be more slender and more gradually tapering posteriorly than *B. fowleri*, which has a distinctly deeper-bodied appearance and tapers more abruptly to the tail. Based on the available specimens, *B. fowleri* is somewhat smaller; the largest specimen is 497 mm compared to 715 mm in *B. parvibranchialis*. Finally,

B. fowleri appears to live in shallower water than *B. parvibranchialis*, based on the collection records of the known specimens, 388–527 m for *B. fowleri* and 432–1022 m for *B. parvibranchialis*.

Ideally, the largest specimen would have been chosen as the holotype, but that specimen has a damaged tail and is missing a few vertebrae at the posterior end. The second-largest specimen, USNM 93376, has a complete vertebral column and was selected on that basis.

***Bathyuroconger hawaiiensis* sp. nov.**

English name: Hawaiian large-toothed conger

Figs. 4, 8B; Tables 2, 3

Bathyuroconger vicinus (non Vaillant, 1888): Smith, 1989a:541; Chave & Mundy, 1994:381; Mundy, 2005:140.

Holotype. USNM 348215 (392 mm), Hawaiian Is. north of Maui, 21.10°N, 156.23°W, 640–686 m, Townsend Cromwell sta. 35-24, 5 Apr. 1968.

Paratypes. BPBM 21071 (7, 241–315), Hawaiian Is., 21.08°N, 156.18°W, 623–667 m, Townsend Cromwell sta. 40-87, 23 Nov. 1968 USNM 441777 (2, 280–292), same data as holotype.

Non-types (detailed counts and measurements not taken). BPBM 24336 (2, 600–675), 21.10°N, 156.22°W, 631–705 m, Townsend Cromwell sta. 40-86, 23 Nov. 1968. BPBM 25042 (2, 280–335, same data as BPBM 24336. BPBM 24044 (4, 340–645, 21.08°N, 156.18°W, 623–667 m, Townsend Cromwell sta. 40-87, 23 Nov. 1968. BPBM 25072 (1, 415), Pailolo Channel, mid-channel, 650 m, 6 Mar. 1971. BPBM 25074 (1, 434), Pailolo Channel, mid-channel, Townsend Cromwell sta. 52-88, 10 Mar. 1971. BPBM 25090 (3, 619–694), 21.02°N, 156.13°W, 860 m, Townsend Cromwell sta. 61-66, 26 Oct. 1972.

Diagnosis. A species of *Bathyuroconger* with a slightly reduced gill opening, separated from pectoral-fin base by a distance of less than diameter of gill opening; total vertebrae 201–210; color medium to dark brown.

Description. Measurements in %TL: PAL 34.7–38.7, PDL 12.8–14.8, HL 12.2–14.3, TR 22.5–25.2, DA 4.8–5.7. In % PAL: PDL 34.5–40.2, HL 34.0–38.6, TR 61.4–66.0, DA 13.6–15.0. In % HL: S 26.1–30.0, E 13.8–18.0, IOW 11.3–13.8, UJ 37.4–44.5, GO 6.8–11.3, IB 10.2–16.6, PL 18.8–31.7. Pores: PDLL 8, PPLL 7, SO 3, IO 5, POM 9–10, ST 1. Vertebrae: PDV 10–13, PAV 51–55, PCV ca. 58–63, TV 201–210.

Body slender, cylindrical anteriorly, gradually tapering and compressed posteriorly. Trunk short, trunk length 1.6–1.9 times head length. Tail thin, anus anterior to mid-body at slightly more than one-third total length. Dorsal and anal fins confluent with caudal, dorsal fin begins slightly behind base of pectoral fin, anal fin begins immediately behind anus. Head stout, rounded, deeper than body; jaws nearly equal. Snout short and blunt, rounded in dorsal view, about 1.5–2.1 times eye diameter. Eye moderate, over posterior third of upper jaw, posterior margin at level of rictus; interorbital space slightly less than eye diameter. Anterior nostril short and tubular, at front of snout; posterior nostril in front of mid-eye, a simple pore. Gill opening reduced, its upper margin not contacting base of pectoral fin, separated from base of fin by a distance of about half diameter of gill opening.

Head pores moderately enlarged, not elongate and slit-like. Supraorbital pores 3; first pore small, at tip of snout on edge of upper lip, opening ventrally; second pore larger, at level of and anterior to anterior nostril; third pore slightly larger and above posterior margin of anterior nostril; no pores on interorbital space. Infraorbital pores 5; first immediately behind anterior nostril; second between anterior and posterior nostrils; third below anterior margin of eye; fourth below posterior third of eye; fifth behind rictus; no pores behind eye. Preoperculo-mandibular pores 10; 7 on mandibular section, 6 before and 1 behind rictus; 3 on preopercular section, progressively larger posteriorly, the last one at about level of first lateral-line pore. One median supratemporal pore, anterior to first lateral-line pore. Lateral line complete, lateral-line pores large; predorsal 8, prepectoral 7.

Vertebrae: predorsal 10–13, preanal 51–55, precaudal ca. 58–63, total 201–210.

Teeth pointed, variable in size. Intermaxillary teeth in 2 transverse rows of about 4–6 teeth each, enlarged and fang-like, exposed when mouth closed. Vomer with 2 enlarged median teeth, with a few smaller teeth around and behind, the row relatively short. Maxillary teeth in 3 rows anteriorly and 2 posteriorly, the outer teeth larger. Dentary teeth in about 3–4 irregular rows anteriorly narrowing to 2 rows posteriorly, the outer teeth larger; the anteriormost teeth enlarged and fang-like, exposed when mouth closed.

Color in preservative medium to dark brown; interior of mouth with some dark pigment; gill cavity and digestive tract black.

Distribution. Hawaiian Islands. Bathymetric range 600–860 m.

Etymology. Named for the type locality.

Remarks. This species has been known for some time, but it was identified as *Bathyuroconger vicinus*, which has been considered world-wide in distribution. The difference in the form of the gill opening was not noticed previously. The high vertebral count separates it from all other known species of *Bathycongrus* except the *B. cf. vicinus* specimens reported below, which have an unreduced gill opening in contact with the pectoral-fin base. The lateral-line pores in the type specimens could not be counted because of damage to the skin on the side of the body.

***Bathyuroconger parvibranchialis* (Fowler, 1934)**

English name: Small-gill large-toothed conger

Figs. 1, 4, 8C, 9A, C; Tables 2, 3

Silvesterina parvibranchialis Fowler, 1934:275, fig. 35 (Butung [Buton] Strait, Indonesia, 5°35'00"S, 122°20'00"E, Albatross station 5648, depth 559 fathoms).

Bathyuroconger parvibranchialis (Fowler, 1934): Smith, 1999:1686. Ho *et al.*, 2015:145.

Bathyuroconger vicinus (non Vaillant, 1888): Hatooka, 2002:232 (in part).

Materials examined. Indonesia: USNM 92346 (1, 645), holotype, 5.58°S, 122.33°E, Buton Strait, North Island, Sulawesi, Flores Sea, 1022 m, Albatross sta. 5648, 16 Dec. 1909. USNM 93370 (1, 525), paratype, 3.33°S, 120.61°E, Gulf of Boni, Olang Point, Sulawesi, Gulf of Boni, 900 m, Albatross sta. 5657, 19 Dec. 1909. **Japan:** NSMT-P 65442 (1, 394), 36.56°N, 141.20°E to 36.51°N, 141.14°E, off Ibaraki Pref., 509–589 m, 25 Oct. 2002. **Philippines:** BSKU 15687 (1, 656), BSKU 15688 (1,715), 8.35°N, 118.33°E, 738 m, Sulu Sea off Palawan Is., 27 May 1972. USNM 93371 (1, 590), paratype, 10.2°N, 125.07°E, Sogod Bay, southern Leyte Island, Limasaua Island, Bohol Sea, 918 m, Albatross sta. 5202, 10 Apr. 1908. USNM 93373 (1, 610), paratype, 9.38°N, 123.71°E, between Siquijor and Bohol Islands, Balicasag Island, Negros Oriental, Bohol Sea, 717 m, Albatross sta. 5527, 11 Aug. 1909. USNM 93374 (1, 595), paratype, 8.28°N, 124.05°E, northern Mindanao and vicinity, Camp Overton Light, Misamis Occidental, Bohol Sea, 924 m, Albatross sta. 5513, 7 Aug. 1909. USNM 93375 (1, 514), paratype, 8.26°N, 123.95°E, northern Mindanao and vicinity, Camp Overton Light, Misamis Occidental, Bohol Sea, 750 m, Albatross sta. 5511, 7 Aug. 1909. USNM 93378 (1, 288), paratype, 13.75°N, 120.78°E, China Sea off southern Luzon, Sombrero Island, Batangas, 432 m, Albatross sta. 5111, 16 Jan. 1908. **Taiwan:** ASIZP 66181, 285 mm, CD321, South China Sea, 954 m, 19 Aug. 2005. ASIZP 63794, 695 mm, CD193, 821 m, off Dong-gang, South China Sea, 29 Aug. 2002. ASIZP 63789, 640 mm, CD194, off Dong-gang, South China Sea, 507 m, 29 Aug. 2002.

Temporary identification. ASIZP 66196, 210 mm, off Suao, NE Taiwan, 339 m, 13 Jun. 2005.

Diagnosis. A species of *Bathyuroconger* with very small gill opening, its width 1.8–9.0% of head length; gill opening separated from pectoral fin base by a greater distance than its width; head length 1.4–1.7 times in trunk length, 35.2–40.9 %PAL; predorsal length 12.6–14.5 %PAL, trunk length 59.1–64.8 %PAL. Preanal lateral-line pores 39–47. Preanal vertebrae 43–48; precaudal vertebrae 52–60; total vertebrae 181–189; MVF 9–46–185. Adults with body uniformly blackish, whereas juveniles are pale with rows of small melanophores.

Description. Measurements in %TL: PAL 33.3–37.1, PDL 12.6–14.5, HL 12.9–14.7, TR 20.4–22.7, DA 3.5–5.2. In % PAL: PDL 36.3–40.9, HL 37.4–40.9, TR 59.1–62.6, DA 14.3–17.7. In % HL: S 23.3–30.7, E 8.5–18.6, IOW 10.8–19.6, UJ 35.6–41.1, GO 1.8–9.0, IB 16.1–32.3, PL 24.2–41.9. Pores: PDLL 6–8, PPLL 5–8, PALL 39–47, SO 3–4, IO 5, POM 10, ST 1. Vertebrae: PDV 7–10, PAV 43–48, PCV 52–60, TV 181–189.

Body moderately slender, cylindrical anteriorly, gradually tapering and compressed posteriorly. Trunk short, truck length 1.4–1.7 times head length. Tail thin but not filamentous, anus at about anterior third of total length. Dorsal and anal fins confluent with caudal, dorsal fin begins over base of pectoral fin, anal fin begins immediately behind anus; pectoral fin moderately well developed. Head large, rounded, deeper than body, jaws nearly equal. Snout short and blunt, rounded in dorsal view, about 2–3 times eye diameter. Eye moderately small, over posterior part of upper jaw, posterior margin approximately over rictus; interorbital space relatively broad, its width greater than eye diameter. Anterior nostril a short tube, at front of snout; posterior nostril in front of mid-eye, a simple pore. Gill opening small, located anteroventrally to pectoral fin, its upper end below level of lower pectoral-fin base; distance from gill opening to fin base 2 or more times greater than diameter of gill opening.

Head pores moderate in size, not greatly enlarged and slit-like. Supraorbital pores 3: first pore at tip of snout,

opening downward, second pore larger, above and behind first, in front of anterior nostril; third pore above anterior nostril; one specimen with an extra pore behind the third; no pores on interorbital space. Infraorbital pores 5, along upper jaw; first directly behind anterior nostril; second between anterior and posterior nostrils; third between anterior margin of eye and posterior nostril; fourth below posterior part of eye; fifth behind rictus; no pores behind eye. Preoperculomandibular pores 10; 7 on mandibular section and 3 on preopercular, the last one at about level of first lateral-line pore. One median supratemporal pore, anterior to level of first lateral-line pore. Lateral line complete, lateral-line pores large; predorsal 6–8; prepectoral 5–8; preanal 39–47. Vertebrae: predorsal 7–10, preanal 43–48, precaudal 52–60, total 181–189.

Teeth large and pointed, generally smaller than those of *B. vicinus*. Intermaxillary teeth in two transverse rows, each with 4–6 fang-like teeth, exposed when mouth closed. Vomer with 2 large median teeth, the posterior one larger, and several smaller teeth behind. Maxillary teeth in 3 irregular rows on anterior portion, becoming 2 rows posteriorly, those on outermost row larger and scattered in arrangement. Dentary with 4 irregular rows of enlarged teeth at anterior end, those on outer 2 rows fang-like and exposed when mouth fully closed, narrowing to 2 rows posteriorly, those of outermost row larger.

Distribution. Indonesia, Japan, Philippines, Taiwan. Bathymetric range 432–1022 m.

Coloration. In preserved adults, body uniformly brown to dark brown, vertical fins with black margins; pores on head and lateral line circled by white; oral cavity, gill chamber, peritoneum, stomach and intestine black. In ASIZP 66196 (210 mm TL), body pale with dorsal half slightly blackish; posterior third of dorsal and anal fins with broad black margin; three rows of black dots on body; oral cavity, tongue, gill chamber blackish; gill opening pale. In ASIZP 66181 (285 mm TL), body much lighter than others; oral cavity, tongue, gill chamber with scattered pigmentation; three rows of dots on body.

Remarks. ASIZP 66196 has a relatively large gill opening (9.1% HL) and the opening is relatively close to the pectoral-fin base, the distance is about half of its diameter, which is more similar to *B. albus* sp. nov. However, it has a relatively short trunk, only 1.4 times of head length, and is thus temporarily identified as the present species.

Bathyuroconger cf. vicinus

Figs. 4, 5C; Tables 2, 3

Bathyuroconger vicinus: Smith, 1989a:541.

Material examined. USNM 135270 (2, 444–475), Indonesia, off NE Borneo, 4°07'00"N, 118°49'54"E, 871 m, Albatross sta. 5585, 28 Sep. 1909. ASIZP 73853 (1, 250+), ASIZP 73804 (1, 276+), ASIZP 73877 (1, 200+), 2°37'48.7"N, 150°2'54.2"E, off Papua New Guinea, 840–865 m, 27 Aug. 2010.

Diagnosis. A species of *Bathyuroconger* with an unreduced gill opening and 196–202 total vertebrae.

Description. Measurements in %TL: PAL 34.7–37.8, PDL 14.6–15.5, HL 13.3–14.6, TR 23.2–24.4, DA 3.8–4.1. In % PAL: PDL 38.7–41.1, HL 35.2–38.6, TR 61.4–64.8, DA 10.2–10.8. In % HL: S 27.0–28.1, E 12.7–14.4, IOW 12.8–14.3, UJ 35.2–35.7, GO 8.1–15.1, IB 19.4–25.0, PL 14.9–16.8. Pores: PALL 47–48, PDL 7–9, PPLL 6–7; SO 3, IO 5, POM 10, ST 1. Vertebrae: PDV 12–13, PAV 49–53, PCV 61–62, TV 196–202.

Body slender, cylindrical anteriorly, gradually tapering and compressed posteriorly, trunk moderately long, trunk length 1.6–1.9 times head length. Tail thin, anus anterior to mid-body at slightly more than one-third total length. Dorsal and anal fins confluent with caudal, dorsal fin begins behind base of pectoral fin, anal fin begins immediately behind anus. Head stout, rounded, deeper than body; jaws nearly equal. Snout short and blunt, rounded in dorsal view, about 1.9–2.2 times eye diameter. Eye moderate, over posterior third of upper jaw, posterior margin at level of rictus; interorbital space about equal to eye diameter. Anterior nostril short and tubular, at front of snout; posterior nostril in front of mid-eye, a simple pore. Gill opening unreduced, its upper margin contacting base of pectoral fin near lower end of fin base.

Head pores moderately enlarged, not elongate and slit-like. Supraorbital pores 3; first pore small, at tip of snout on edge of upper lip, opening ventrally; second pore larger, at level of and anterior to anterior nostril; third pore slightly larger and above posterior margin of anterior nostril; no pores on interorbital space. Infraorbital pores 5; first immediately behind anterior nostril; second between anterior and posterior nostrils; third below posterior nostril; fourth below middle of eye; fifth behind rictus; no pores behind eye. Preoperculomandibular pores 10; 7 on mandibular section, 3 on preopercular section, progressively larger posteriorly, the last one at about level of first

lateral-line pore. One median supratemporal pore, anterior to first lateral-line pore. Lateral line complete, lateral-line pores large; predorsal 7–9; prepectoral 6–7; preanal 42–47. Vertebrae: predorsal 12–13, preanal 49–53, precaudal 61–62, total 196–202.

TABLE 3. Morphometric data of two *Bathyuroconger* species and *B. cf. vicinus* from the Philippines.

	<i>B. hawaiiensis</i> sp. nov.		<i>B. parvibranchialis</i>		<i>B. cf. vicinus</i>
	Holotype	All types	Holotype	Types+nontypes	
TL (mm)	392	241–392 (n=10)	645	288–715 (n=13)	444–475 (n=2)
% TL					
PAL	38.0	36.6 (34.7–38.7)	35.8	35.4 (33.3–37.1)	37.7–37.8
PDL	13.1	13.9 (12.8–14.8)	14.0	13.7 (12.6–14.5)	14.6–15.5
HL	12.9	13.1 (12.2–14.3)	14.3	13.9 (12.9–14.7)	13.3–14.6
Tail	62.0	63.4 (61.3–65.3)	64.2	64.6 (62.9–66.7)	62.2–62.3
TR	25.1	23.5 (22.5–25.2)	21.6	21.6 (20.4–22.7)	23.2–24.4
DA	5.7	5.2 (4.8–5.7)	5.2	4.2 (3.5–5.2)	3.8–4.1
TR/HL	1.9	1.8 (1.6–1.9)	1.5	1.6 (1.4–1.7)	1.7 (1.6–1.9)
% PAL					
PDL	34.5	37.9 (34.5–40.2)	39.0	38.5 (36.3–40.9)	38.7–41.1
HL	34.0	35.9 (34.0–38.6)	39.8	39.2 (37.4–40.9)	35.2–38.6
TR	66.0	64.1 (61.4–66.0)	60.2	60.8 (59.1–62.6)	61.4–64.8
DA	15.0	14.2 (13.6–15.0)	14.6	16.3 (14.3–17.7)	10.2–10.8
%HL					
S	27.1	27.9 (26.1–30.0)	27.4	26.1 (23.3–30.7)	27.0–28.1
E	15.8	15.3 (13.8–18.0)	10.8	12.4 (8.5–18.6)	12.7–14.4
IOW	13.8	12.6 (11.3–13.8)	19.6	15.8 (10.8–19.6)	12.8–14.3
UJ	38.9	40.8 (37.4–44.5)	39.0	37.9 (35.6–41.1)	35.2–35.7
GO	11.3	8.5 (6.8–11.3)	4.8	5.0 (1.8–9.0)	8.1–15.1
IB	14.8	12.9 (10.2–16.6)	23.4	23.2 (16.1–32.3)	19.4–25.0
PL	18.8	25.3 (18.8–31.7)	37.1	36.2 (24.2–41.9)	14.9–16.8

Teeth pointed, variable in size. Intermaxillary teeth in 2 transverse rows of about 4–6 teeth each, enlarged and fang-like, exposed when mouth closed. Vomer with 1 or 2 enlarged median teeth, with a few smaller teeth around and behind, the row relatively short. Maxillary teeth in 3 rows anteriorly and 2 posteriorly, the outer teeth larger. Dentary teeth in about 3–4 irregular rows anteriorly, narrowing to 2 rows posteriorly, the outer teeth larger; the anteriormost teeth enlarged and fang-like, exposed when mouth closed.

Color in preservative medium to dark brown; interior of mouth, gill cavity, digestive tract, and peritoneum black.

Remarks. These specimens were included by Smith (1989a) in his account of *Bathyuroconger vicinus*, provisionally treated as a single world-wide species. He did not mention their unusually high vertebral counts, which would have grouped them with the Hawaiian specimens and separated them from the Atlantic and Indian Ocean specimens. Karmovskaya (2004:S20) reported six specimens from the South Pacific (Norfolk Island Ridge, Loyalty Ridge, Marquesas Islands) with vertebral counts of ca. 200–205, which are close to the values of the specimens reported here but also to *B. hawaiiensis*. She did not mention the condition of the gill opening. Specimens from the Indian and Pacific Oceans need to be examined and compared in more details in order to determine what species are present and where they occur. In the meantime, we refer to the present specimens as *Bathyuroconger cf. vicinus*.

The third infraorbital pore is somewhat more anterior in this species than in the others, under the posterior nostril and distinctly before the eye.

The three specimens collected from Papua New Guinea have the same coloration and the same gill size as the two Indonesian specimens, but their tails are damaged and the total vertebral counts are unavailable. They are provisionally treated as the same species herein.

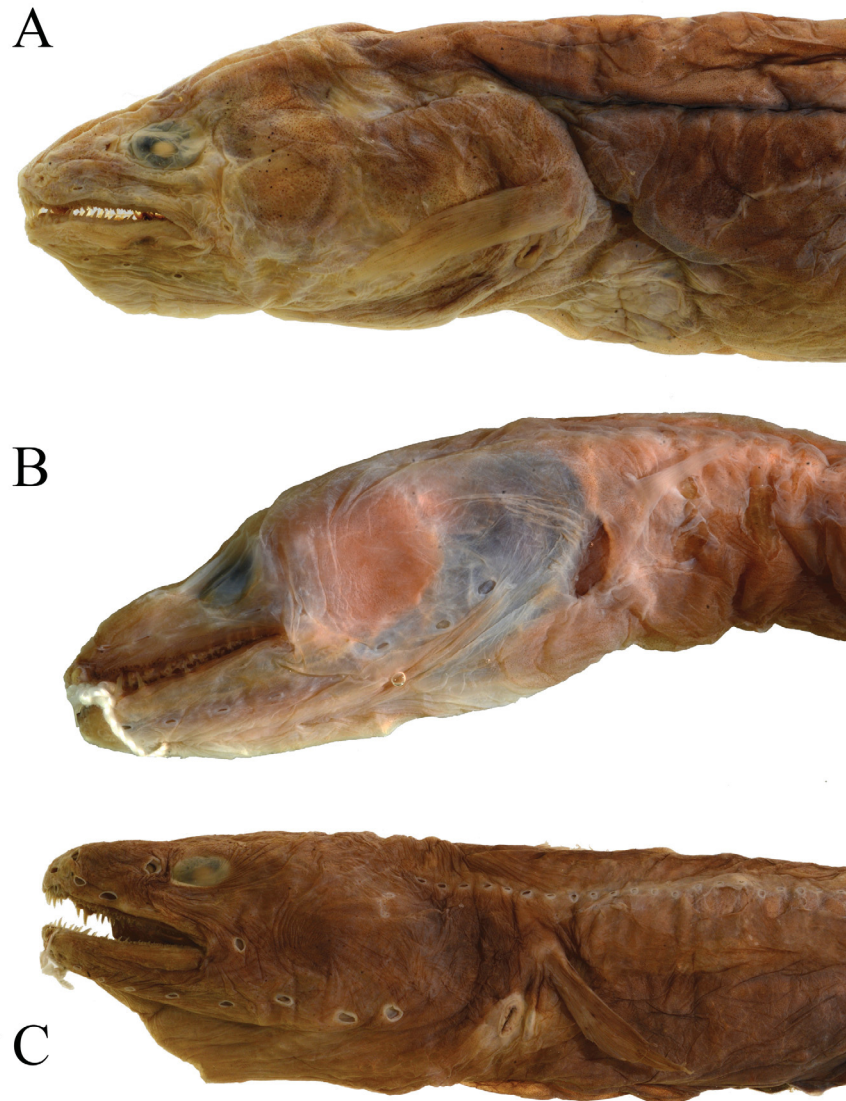


FIGURE 8. Lateral view of head of three *Bathyuroconger* species. A. *B. fowleri* **sp. nov.**, paratype, USNM 93372, 497 mm TL. B. *B. hawaiiensis*, holotype, USNM 348215, 392 mm TL. C. *B. parvibranchialis*, holotype, USNM 92346, 645 mm TL.

Discussion

Prior to the present paper, only two or three species were recognized in the genus *Bathyuroconger*. *Bathyuroconger vicinus* was described from the Atlantic and usually recognized as a single world-wide species. *Bathyuroconger braueri* was described from the Indian Ocean. Although sometimes recognized as distinct, it was usually treated as a synonym of *B. vicinus*. The only other species recognized was *B. parvibranchialis*, known only from the Philippines and Indonesia. We have expanded the number of known species to six in the western North Pacific. Of these, the newly described species *B. albus* and *B. dolichosomus* are known only from Taiwan. The known range of *B. parvibranchialis* has been extended to include Taiwan and Japan. The new species *B. fowleri*, formerly confused with *B. parvibranchialis*, is known from Indonesia and the Philippines. *Bathyuroconger hawaiiensis* was reported earlier as *B. vicinus*, but it is distinguished by its reduced gill opening and is thus described as new.

The six species of *Bathyuroconger* treated here are very similar in overall appearance. The dentition is essentially the same in all of them, with only a slight difference in the size of the teeth. The number and arrangement of head pores shows little variation among the species. The characters that distinguish the various species are the size and position of the gill opening, the coloration, and several morphometric and meristic characters.



FIGURE 9. A. holotype of *Bathyuroconger parvibranchialis* (Fowler, 1934), USNM 92346, 645 mm TL; compared with holotype of *B. fowleri*, USNM 93376 (B). C. fresh condition of *B. parvibranchialis*, ASIZP 63789, nontype, 640 mm TL.

The degree of variation in the gill opening was not previously recognized. *Bathyuroconger vicinus* and *B. cf. vicinus* have a full-size gill opening in contact with the pectoral-fin base. *Bathyuroconger parvibranchialis* and *B. fowleri* have a greatly reduced gill opening distinctly separated from the pectoral fin by a distance greater than the diameter of the gill opening. *Bathyuroconger albus*, *B. dolichosomus*, and *B. hawaiiensis* are intermediate in this condition, with the gill opening separated from the pectoral fin, but by a distance less than the diameter of the gill opening.

Bathyuroconger albus and *B. dolichosomus* are lighter in color than the others, which tend to be a more-or-less uniform medium to dark brown.

Tables 1 and 2 show the morphometric and meristic characters in each species. *Bathyuroconger dolichosomus* has a greater trunk length than any of the others, 76.1 %PAL or 3.2 times HL vs 59.1–66.7 %PAL or 1.4–2.9 times HL in the others. Several other morphometric characters show differences between species, although there is some overlap in all of them. *Bathyuroconger albus* has the smallest head, 11.0–12.6 %TL, which is similar to *B. vicinus* (11.2–13.1 %SL), while the others range from 12.2–14.7 %TL. This value is not available for *B. dolichosomus*, but *B. dolichosomus* has a small head compared to its preanal length (23.9 %PAL vs 25.6–40.9 %PAL). The snout is shorter in *B. albus* and *B. fowleri* (21.5–26.0 %HL) than the others (23.3–30.7 %HL). The dorsal-fin origin is more anterior in *B. hawaiiensis* and *B. parvibranchialis* than in the other species, over or nearly over the pectoral-fin

base vs. over the middle of the fin. This is reflected in the predorsal length, 12.6–14.8 %TL in the two species mentioned vs 13.8–16.2 %TL in the others, except for *B. vicinus* has a intermedia value of 12.9–15.4 %TL.

Bathyuroconger hawaiiensis and *B. cf. vicinus* have the most total vertebrae (201–210 and 196–202, respectively). *Bathyuroconger parvibranchialis* has an intermediate number (181–189), and *B. albus* (173–175) and *B. fowleri* (173–178) have the fewest. *Bathyuroconger dolichosomus* has the most preanal vertebrae (63) and *B. parvibranchialis* has the fewest (43–48). The other species have intermediate values. *Bathyuroconger parvibranchialis* has the fewest predorsal vertebrae (7–10 vs 10–14), reflecting the anterior position of the dorsal-fin origin. *Bathyuroconger dolichosomus* has the most precaudal vertebrae (70 vs. ca. 52–63 in the other species).

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References

- Blache, J. & Bauchot, M.-L. (1976) Contribution à la connaissance des poissons Anguilliformes de la côte occidentale d'Afrique. 16e note: les familles des Congridae et des Colocongridae. *Bulletin de l'Institut Français d'Afrique Noire*, Série A, Sciences Naturelles, 38 (2), 369–444.
- Castle, P.H.J. (1968) The congrid eels of the western Indian Ocean and the Red Sea. *Ichthyological Bulletin Department of Ichthyology Rhodes University*, 33, 685–726.
- Castle, P.H.J. (1969) The eel genera *Congrina* and *Coloconger* off southern Mozambique and their larval forms. *Special Publication J.L.B. Smith Institute of Ichthyology Rhodes University, Grahamstown*, 6, 1–10.
- Chave, E.H. & Mundy, B.C. (1994) Deep-sea benthic fish of the Hawaiian archipelago, Cross Seamount, and Johnson Atoll. *Pacific Science*, 48 (4), 367–409.
- Fowler, H.W. (1934) Descriptions of new fishes obtained 1907 to 1910, chiefly in the Philippine Islands and adjacent seas. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 85, 233–367.
- Fricke, R. & Eschmeyer, W.N. (2018) Guide to Fish Collections. Electronic Version. Available from: <http://researcharchive.calacademy.org/research/ichthyology/catalog/collections.asp> (accessed 29 January 2018)
- Hatooka, K. (2002) Family Congridae. In: Nakabo, T. (Ed.), *Fishes of Japan with pictorial keys to the species. English Edition*. Tokai University Press, Tokyo, pp. 227–234.
- Ho, H.-C., Smith, D.G., McCosker, J.E., Hibino, Y., Loh, K.-H., Tighe, K.A. & Shao, K.-T. (2015) Annotated checklist of eels (orders Anguilliformes and Saccopharyngiformes) from Taiwan. *Zootaxa*, 4060 (1), 140–189. <https://doi.org/10.11646/zootaxa.4060.1.16>
- Karmovskaya, E.S. (2004) Benthopelagic bathyal conger eels of families Congridae and Nettastomatidae from the western tropical Pacific, with descriptions of ten new species. *Journal of Ichthyology*, 44 (Supplement 1), S1–32.
- Mundy, B.C. (2005) Checklist of the fishes of the Hawaiian Archipelago. *Bishop Museum Bulletins in Zoology*, 6, 1–703.
- Nair, R.V. (1946) On the leptocephalus of *Uroconger lepturus* (Richardson) from the Madras plankton. *Current Science*, 15, 318–319.
- Nair, R.V. & Mohamed, K.H. (1960) Studies on the leptocephali of Bombay waters, 3: the metamorphosing stages of *Uroconger lepturus* (Richardson). *Proceedings of the Indian Academy of Sciences*, 52 B (5), 182–190.
- Reid, E.D. (1934) Two new congrid eels and a new flatfish. *Smithsonian Miscellaneous Collections*, 91 (15), 1–11, pl. 1.
- Richardson, J. (1845) Ichthyology. Part 3. In: Hinds, R.B. (Ed.), *The zoology of the voyage of H. M. S. Sulphur, under the command of Captain Sir Edward Belcher, R. N., C. B., F. R. G. S., etc., during the years 1836–42. No. 10*. Smith, Elder & Co., London, pp. 99–150. [pls. 55–64]
- Shao, K.-T., Ho, H.-C., Lin, P.-L., Lee, P.-F., Lee, M.-Y., Tsai, C.-Y., Liao, Y.-C. & Lin, Y.-C. (2008) A checklist of the fishes of southern Taiwan, Northern South China Sea. *Raffles Bulletin of Zoology*, 19 (Supplement), 233–271.
- Smith, D.G. (1989a) Family Congridae. In: Böhlke, E.B. (Ed.), *Fishes of the Western North Atlantic. Memoirs of the Sears Foundation for Marine Research*, 1 (Part 9), pp. 460–567.
- Smith, D.G. (1989b) Family Congridae: Leptocephali. In: Böhlke, E.B. (Ed.), *Fishes of the Western North Atlantic. Memoirs of the Sears Foundation for Marine Research*, 1 (Part 9), pp. 723–763.
- Smith, D.G. (1999) Species identification guide for fisheries purposes. Vol. 3. In: Carpenter, K.E. & Niem, V.H. (Eds.), *The*

- living marine resources of the western central Pacific. Batoid fishes, chimeras and bony fishes. Part 1. Elopidae to Linophrynidae*). FAO, Rome, pp. 1398–2068.
- Vaillant, L.L. (1888) *Expéditions scientifiques du "Travailleur" et du "Talisman" pendant les années 1880, 1881, 1882, 1883*. Poissons, Paris, 406 pp., 28 pls.
- Weber, M. & de Beaufort, L.F. (1916) *The fishes of the Indo-Australian Archipelago. III. Ostariophysi: II. Cyprinoidea, Apodes, Synbranchi*, E. J. Brill, Leiden, 455 pp.